Wilkins, naturalist; Mr. J. C. Bee-Mason, photographer and kinematographer; Mr. G. Smith, second engineer; Mr. J. Dell, electrician; Mr. Harold Watts, wireless operator; D. Ericson, gunner; C. J. Green, cook; Boy Scouts N. E. Mooney and J. W. Marr. The members of the scientific staff enumerated above will also work the ship, and on leaving Plymouth two additional members were shipped for the first part of the voyage in the persons of Mr. Gerald Lysaght and Mr. McLeod. Of the complete ship's company of twenty all told, no fewer than five accompanied Sir Ernest Shackleton on his Antarctic expedition in the *Endurance* in 1914.

Obituary.

DR. WALTER GEORGE RIDEWOOD.

DR. WALTER G. RIDEWOOD, whose sudden death occurred on September 19, was born in London on February 1, 1867. He was educated at Enfield Grammar School, of which his father, Mr. W. S. Ridewood, was headmaster for many years. He was at the Royal College of Science from 1883 to 1887, becoming an associate and taking first classes in both biology and geology. In 1888 he took his B.Sc. degree in the University of London, with first-class honours in zoology, and in 1897 he became D.Sc. In the meantime, in May, 1888, he had been appointed assistant to the director at the British Museum (Natural History), where he was employed in making the wonderful series of anatomical preparations exhibited in the Central Hall of that institution. In this kind of work Dr. Ridewood was without rival, his extraordinary manual skill and technical knowledge being supplemented by a thorough grasp of the principles of morphology and a close acquaintance with its literature. He also organised and prepared several special exhibitions, among the most important being the Darwin Centenary Exhibition and the series of preparations illustrating the different modes of flight in the animal kingdom. This series is still on exhibition, and is an excellent example of his work. For these and other exhibitions he prepared valuable illustrated guide-books. He severed his connection with the British Museum in 1917, after twenty-nine years' service, his resignation being greatly regretted by his colleagues.

In addition to, and for the most part relating to, his work in the museum Dr. Ridewood published a long series of valuable memoirs, mostly dealing with the comparative anatomy of the Vertebrata. Only some of the more important of these can be referred to: "On the Cranial Osteology of the Teleostei" (five papers in the Proc. Zool. Soc., 1904, and in the Journ. Linn. Soc., vol. 29: these were intended to be used in a general work on the osteology of fishes, never published); "On the Air-bladder and Ear in the British Clupeoid Fishes" (*Journ. of Anatomy*, vol. 26); "On the Structure and Development of the Hyobranchial Skeleton and Larynx in Xenopus and Pipa" (Journ. Linn. Soc., vol. 26: this was his thesis for the D.Sc. degree). He also wrote on a new species of Cephalodiscus from the Cape Seas, and on the Pterobranchia of the Antarctic (*Discovery, Scotia,* Australasian, and *Terra Nova* Expeditions). His chief paper relating to the Invertebrata is the "Monograph on the Gills of the Lamellibranchia" (Phil. Trans., 1903); this he illustrated by a series of models in the British Museum. His last published work is an important memoir, "On the Calcification of the Vertebral Centra in the Sharks and Rays" (Phil. Trans., 1921). In this he was able to show that Hasse in his great work on the same subject had "overestimated the importance of the disposition of the calcified masses and laminæ in the centrum as a taxonomic feature." Another completed paper on the development of the skull in the whalebone whales remains to be published.

Dr. Ridewood was a man of a singularly quiet and retiring disposition, which perhaps in some cases led to his real character being misunderstood. Actually his reticence was a mask covering a genuine kindliness which often showed itself in the great amount of trouble he would take to help anyone who asked for his advice and assistance. During the war he drove a Red Cross ambulance in France for nearly two years.

Apart from zoology, Dr. Ridewood's chief interest was in music. He was an extremely good performer on the flute, and for many years was a member of various amateur orchestras, especially of the Strolling Players. He made a thoroughly scientific study of his favourite instrument, but does not seem to have published anything on the subject.

He was for twenty-three years lecturer on biology in the Medical School of St. Mary's Hospital, London, and was reader in zoology in the University of London. He was also a life member of the Linnean, Geological, Zoological, and Malacological Societies.

C. W. A.

Notes.

WE learn from the *Times* that Sir Thomas Holland, who recently resigned his post as Minister of Industries in the Governor-General of India's Council as a protest against the suspension of prosecution in connection with alleged corrupt practices in the supply of munitions, left Simla on Friday last for England. The whole facts of the case are not before us, but so far as we can make them out Sir Thomas Holland has been sacrificed to political expediency. In a recent speech the Viceroy, Lord Reading, suggested that the trouble would not have arisen had the post of Minister of Industries been filled by a lawyer instead of a man of science, and we may put our own interpretation upon this view. Sir Thomas Holland appears, however, to have consulted two members of the Viceroy's Council, one of whom was probably the legal member, before censuring the official and firms involved in the Calcutta munitions case, and the gravity of his offence was that he did not consult the Viceroy himself. But surely it is the duty of the legal member of the Council to advise his non-legal colleagues, and if Sir Thomas Holland had his approval that ought to have been sufficient. If nothing can be done in India without consulting the Viceroy personally, administration will be slower than ever. The truth seems to be that Sir Thomas Holland made many enemies by his attacks on profiteers, and their hostility, with that which lawyer administrators often display towards scientific men who enter what they consider to be their own special preserves, has resulted in the removal of one who was to them a troublesome Minister. Whatever may be said in favour of the strictly legal view of the case, common sense is on the side of Sir Thomas Holland, who may be assured that his action will be supported by scientific workers everywhere. The claim that a Minister of Industries should necessarily be a lawyer is one against which we must enter the strongest protest both on account of science and of efficiency. We trust that when Parliament meets the whole question will be raised in the interests of probity and justice.

THE announcement in the *Times* of September 24 of the successful synchronisation of speech and action in kinematography by means of photographic films bearing suitable sound records is the natural outcome of the work expended on this problem in numerous different countries. Sweden, through MM. Bergland and Frestadius, has apparently been fortunate enough to reach success first. It is indeed surprising that the achievement has been so long delayed. Speaking-films, apart from synchronisation, have been in existence for a long time, having been first made by Ernst Rühmer about 1900, and called by him the "photographophone." Rühmer made his films by photographing upon them the fluctuating light proceeding from a "speaking arc," and the reproduction was effected by making use of the well-known property of selenium of controlling a telephonic current when actuated by variable illumination. More recently (Proc. Phys. Soc., vol. 32, p. 78) Prof. A. O. Rankine has made speaking-films by a different method, in which the voice imposes fluctuations of intensity on a beam of light issuing from a constant source, the reproduction from the film record again being by means of selenium. The whole problem is closely related to telephony by light, of which a description was given in NATURE of February 5, 1920 (vol. 104, p. 604). In photo-telephony the speech is transmitted by light and reproduced immediately; in speaking-films a photographic record is made for future reproduction. The *Times* article does not make quite clear by what process M. Bergland makes the sound-film, but it probably does not differ fundamentally from those previously used. The novelty of M. Bergland's work appears to be the successful realisation of synchronism between the picture-bearing and the sound-record-bearing films. This has been done by the obvious method of running the two films on the same shaft, both during the taking of the double record of action and speech and during reproduction. In addition, sufficient valve amplification to actuate a loud-speaking telephone has been successfully applied to the selenium-controlled currents.

A PUBLIC meeting was held in Edinburgh on September 13 last under the auspices of the National Union of Scientific Workers, when Prof. H. Levy delivered an address entitled "The Function of the Scientist in Organised Research." Prof. Levy laid stress on the fact that by research new fields of inquiry were being opened up and new crafts being created. The status of the work itself, as well as that of the worker, must therefore receive consideration. Any tendency to make research a commercial undertaking was deprecated as liable to stifle investigations of fundamental importance, though possibly of an abstract nature. For the direction of research it was suggested that the best administrators would be men of scientific attainments who understood the conditions best adapted for good work; men of science must therefore be trained in administration. On the other hand, the idea of training the administrator in research was regarded as out of the question, the two faculties being, when approached in this order, diametrically opposed. As regards the status of the research worker, it was maintained that such security of tenure must be granted as would admit of unfettered criticism, and that the remuneration attached to appointments of a scientific nature, whether administrative or practical, should correspond with that attached to posts of a similar grade in other branches of Government service. The co-operation of men of science of all kinds was necessary in order to promote the interests of research.

DISPATCHES from Col. Howard Bury to the *Times* describe the further efforts of the Mount Everest Expedition to find a practicable route to the summit of the mountain. Unfavourable weather at the end of August having interfered with mountain climbing, Col. Howard Bury and Mr. Wollaston explored the lower valley of the Kamachu from the expedition's base at Kharta. They crossed the Samjunla at 15,000 ft. and the Chogla at 16,100 ft., reaching a remarkable lake called Ruddamlamtso, which is regarded as holy and is the destination of annual pilgrimages. Two thousand feet above the lake is the village of Sakideng, once a place of considerable size, but now practically deserted since a pestilence wiped out the inhabitants. From Sakideng Col. Bury descended the Kama and Kamachu valleys, which were found to be densely forested. The Arun Valley was reached at about 7500 ft. The village of Lungdoe, some 4000 ft. above the river, was found to lie in a region of great fertility and luxuriant crops of millet, cucumbers, and pumpkins.

LATER news from Col. Howard Bury, published in the *Times*, is to the effect that the approach to Mount Everest up the Kamachu or Shinchu Valley, indicated by the local inhabitants, proved to be useless. No possible way was discovered of ascending the cliffs surrounding the Kamgshung glacier. Attention was then turned to the upper valley of the Kharta, about which nothing could be learnt from the inhabitants. Ascending the glacier at the head of the valley the explorers ascended gentle slopes through deep snow to a col at 23,000 ft., from which it appeared possible to reach the northern ridge of Mount Everest. Soft snow and warm weather prevented any further advance, so that efforts were concentrated on preparing a base as high as possible. With this end in view a camp was established about eighteen miles up the Kharta Valley at about 17,500 ft., a second camp at about 20,000 ft., and a third camp at the 23,000-ft. col. It is possible a fourth camp was to be made between 23,000–24,000 ft. on the slopes of Mount Everest itself. Messrs. Mallory and Bullock left Kharta on August 31 for the advanced camp to await suitable weather conditions. Mr. Raeburn has rejoined the expedition.

THE *Quest,* with the Shackleton-Rowett Expedition on board, was given an enthusiastic send-off on leaving Plymouth for the south on September 24. The first stage of the journey is to the Salvage Island, a small group of rocky islets occasionally visited by Portuguese fishermen, but otherwise uninhabited, lying 160 miles south of Madeira and 85 miles from Teneriffe. From there the *Quest* will sail *via* St. Paul's Rocks, South Trinidad, Tristan da Cunha, and Gough Island to Cape Town, where she is due about December 1. Sir Ernest Shackleton announces that the expedition is fully equipped for deep-sea research and meteorological work, and will pay particular attention to magnetic observations. In wireless equipment the ship has two transmitting sets, one with a night range of 2000 miles, a receiving set fixed on board, two shore sets which can if necessary be used in her lifeboats, and a small set for the seaplane. A slight change in plans is announced; after returning from the Weddell Sea *via* South Georgia and Bouvet Island the *Quest* will visit Cape Town a second time before leaving for the Marion and Heard Islands and the Pacific.

THE number of ordinary scientific meetings of the Chemical Society to be held during the coming year has been increased with the object of affording greater facilities for papers to be read before the society. The first meeting will be held at Burlington House on Thursday, October 6, at 8 p.m. Following the custom of the last few years, the council has again arranged for the delivery during the session of three special lectures which, by the courtesy of the council of the Institution of Mechanical Engineers, will be held in the lecture-hall of that institution (Storey's Gate, S.W.1). The first, entitled "The Genesis of Ores," will be delivered by Prof. J. W. Gregory on Thursday, December 8, at 8 p.m. On February 9th, 1922, Sir Ernest Rutherford will lecture on "Artificial Disintegration of Elements"; while the last lecture, by Dr. H. H. Dale, entitled "Chemical and Physiological Properties," will be held on June 8, 1922.

THE Scientific and Technical Group (of members) of the Royal Photographic Society has just issued the third quarterly number of "Photographic Abstracts." It contains nearly 300 classified abstracts of publications concerning photography from practical and theoretical points of view, besides descriptions of the published results of those whose pleasure or duty it is to investigate the innumerable scientific problems connected with photography and its applications to the various branches of science and industry. There is also a classified list of about ninety recently issued patents, which deal chiefly with details of mechanism, given in title only, with full information as to the country of origin, the date and the official number, and finally an index of authors' names. Practically speaking, the journal is a descriptive index of the progress of photography in all its various aspects and applications, and it should meet with a wide appreciation, not only by photographers, but also by students, scientific investigators, photographic manufacturers, and those engaged in any industry in which photography is utilised. Those who conduct the journal merit hearty congratulations that they have in the third number brought it to such a pitch of perfection.

THE Department of Scientific and Industrial Research announces that the MS. copy of the "Bibliography of Lubricants" compiled by the Lubricants and Lubrication Inquiry Committee, referred to in the Report of the Committee of the Privy Council for 1919–20 (Cmd. 905), has been placed in the library of the Department at 16–18 Old Queen Street, Westminster, S.W.1, and is available for reference. Owing to the expense which would be involved, it is not possible to print this bibliography as originally intended. The bibliography contains in a classified form references to every paper on lubricants and lubrication which was considered by the Committee as being of definite importance. It is divided into two main parts, the papers being classified according to authors and subjects. The references themselves are divided into two sections, one dealing with the chemical, the other with the engineering and physical aspects of the subject.

FREE public lectures are to be delivered at the Horniman Museum, Forest Hill, S.E., each at 3.30 o'clock, as follow:—On October 8, "The Life and Habits of Mason Bees," F. Balfour-Browne; on October 15, "The Egyptian Pyramids," Miss M. A. Murray; on October 22, "Dredging for Marine Animals," H. N. Milligan; on October 29, "The Folk-lore of Seafaring Men," E. Lovett; on November 5, "A Naturalist on the African Lakes," Dr. W. A. Cunnington; on November 12, "Insect Collecting and its Value," F. Balfour-Browne; on November 19, "The Dawn of History in Egypt," Miss M. A. Murray; on November 26, "The Natural History of Dogs," H. N. Milligan; on December 3, "Exploring on Lake Mœris (Lower Egypt)," Dr. W. A. Cunnington; and on December 10, "Folk-lore Records from Italy, France, and Belgium," E. Lovett.

THE annual meeting of the American Metric Association will be held at Toronto on December 29 next.

The objects of the meeting are to bring together public officials, engineers, business men, and others who are interested in securing for the United States and Canada the benefits of the general use of the metric system and to utilise the information thus gained in guiding the metric movement. So far as possible the papers to be presented will outline the steps which would be necessary to make the suggested change in industry and the law. The Britten-Ladd Metric Bill now before the United States Congress will be among the subjects discussed. Suggestions and queries should be sent to the American Metric Association, 156 Fifth Avenue, New York City.

THE following committee has been appointed by the Medical Research Council, in consultation with the Ministry of Health, for the investigation of the causes of dental decay:—Prof. W. D. Halliburton (chairman), Mr. N. G. Bennett, Mr. L. Colebrook, Dr. J. M. Hamill, Sir Arthur Keith, Mrs. E. Mellanby, Mr. J. H. Mummery, and Mr. C. J. Thomas. Dr. J. M. Hamill is the secretary of the committee.

A CONVERSAZIONE of the Royal Microscopical Society will be held at the Mortimer Halls, Mortimer Street, London, W.1, on Wednesday, October 5, from 7.30 to 10.30 p.m.

THE Harveian oration of the Royal College of Physicians of London is to be delivered at 4 o'clock on Tuesday, October 18, by Dr. H. Spencer.

ONE modern school of anthropologists explains the origin of civilisation as starting from Egypt. It is therefore important to investigate how far this dissemination of culture can be recognised in Africa itself. At the Edinburgh meeting of the British Association the question was considered in a paper on "Egyptian Influence on African Death Rites," by Mr. T. F. McIlwraith. He found, particularly on the Guinea coast and in the Congo Valley, cases of desiccation of the corpse, delayed interment without the use of preservatives, burial in coffins decorated with anthropomorphic figures, and statues intended to house the soul or to serve as effigies on the grave. The fact remains that these analogies to Egyptian culture are found in West and Central Africa, not in the nearer regions of the east and south. This, he suggested, could be explained by seafarers from Egypt founding a centre on the Congo coast, whence elements of Egyptian civilisation penetrated inland or by overland influences, which had been wiped out by later intrusions of pastoral peoples.

IN connection with Mr. A. E. Harris's letter on *Ceratium furca* (NATURE, September 8, p. 42), suggesting that this organism may be moving inland, Mr. J. W. Williams, of Bewdley, Worcester, writes to say that he and Mr. H. Weaver have found the curious organ-pipe diatom *Bacillaria paradoxa*, Gmel., in abundance in the Staffordshire and Worcestershire Canal at Stourport and in Wilden Pool; Mr. Weaver has also found the organism in Charlton Pool and Hartlebury. Mr. Harris states that for a number of years *Bacillaria paradoxa* has been recognised as a constituent of the fresh-water algæ of the dykes and drains of the north-east and east of England, although its normal habitat is in salt or brackish water. That it has been found in districts hitherto unexplored is not necessarily proof that it is actually advancing inland.

SOME interesting observations on two British mammals form the subject of notes in the *Irish Naturalist* for September. Mr. A. W. Stelfox records his observations on a curious flight made one evening in July by a hairy-armed bat (*Nyctalus Leisleri*). The bat made an upward and zigzag flight into the air and continued its ascent until out of sight. Mr. C. B. Moffat, commenting on this note, states that he has witnessed similar ascending zigzag flights on the part of the same species of bat on three occasions, and is of opinion that the animal, which, by reason of its early and short period of flight, must live on day-flying insects, hopes by its ascending flight to find clearer air and a more abundant supply of insects. In the second note Mr. A. Sheals supplies evidence to show that squirrels, contrary to prevailing belief, bring forth their young quite early in the year. Mr. Moffat endorses Mr. Sheal's opinion in a commentative note, and remarks that there is reason to believe that the young squirrels born about midsummer or later are second broods.

MR. R. I. POCOCK writes on otters in the September issue of *Conquest*. His article is prefaced by a general consideration of amphibious mammals, with special reference to those characters acquired independently by species, wholly unrelated to each other, which have adopted the amphibious habit, such as the quality of the fur, the strengthening of the "whiskers" of the upper lip, and a general form of body so built as to offer the least possible resistance to water. Dealing specially with otters, the author notes their world-wide distribution and uniformity in character, due to their habit of entering the sea to fish and their ability to travel along the waterways of the world. Mr. Pocock throughout the article brings out in an interesting manner the correlation of structure with habit. Some otters, like the African otter, have given up aquatic life, and, in consequence, the bristles on the upper lip have lost much of their stiffness and the webs on the feet are reduced in size. The true sea or fur-bearing otter is of special interest in this connection. Compared with fresh-water otters it has a shorter tail, smaller and more delicate fore-paws, and very large flipper-like hind-paws. This is correlated with a general habit of swimming mainly with its hind limbs and the absence of any need for rapid movement through the sea on account of its independence of swift-swimming fishes as food. It feeds mainly on mussels and other shell-fish, crabs, and sea-urchins. The article concludes with a consideration of the affinities of otters. Mr. Pocock supports the generally accepted view that otters are related to the martens, and may be described with considerable truth as aquatic, fish-eating martens.

AN illustrated account of the trials of the motor tanker *Conde de Churruca* appears in the *Engineer* for September 16. This vessel was constructed by

Sir W. G. Armstrong, Whitworth and Co., Ltd., and has twin screws driven by Armstrong-Sulzer Diesel engines. These engines are the largest engines of the type which have, up to the present, been fitted in a British mercantile vessel. The vessel has been constructed on the Isherwood longitudinal system, and is 370 ft. long; the gross tonnage is 4550, and the mean draught is 24 ft. 3 in. with 6500 tons dead-weight on board; under these conditions the speed is 11½ knots. Each engine has four cylinders, 600 mm. bore and 900 mm. stroke, and develops 1250 brake-horse-power at 100 revs. per min. During the trials the fuel consumption of the main engines was 0·421 lb. per brake-horse-power per hour. The pistons are cooled by the Sulzer spray system, in which a spray of sea-water plays inside the piston and is discharged against its inner walls. The system works under atmospheric pressure with an open discharge, so that the engineer can gauge the temperature of each piston and cylinder unit.

A PARTNERSHIP is announced between Sir Charles Bright, Mr. A. Hugh Seabrook (late chief engineer and general manager to the St. Marylebone, London, and other electric supply undertakings), Mr. A. J. Stubbs (late Assistant Engineer-in-Chief, H.M. Post Office), and Lt.-Col. H. W. Woodall (director and consulting engineer of gas and water companies) under the style of Sir Charles Bright and Partners, consulting engineers, with offices at 146 Bishopsgate, E.C.2. The establishment of this firm is of scientific interest on account of the unusual combination of experts represented by it, which marks a development of the co-operation of gas and electricity. In addition to advising upon the installation and operation of telegraphs, telephones, and wireless and electrical undertakings generally, the firm may be consulted upon gas, water, and colliery engineering. In view of the heavy cost of fuel, economies have to be studied to-day that were negligible before the war. The firm is specialising in fuel conservation in relation to the design and construction of power plants—steam, gas, electric, hydro-electric, and oil—and particular attention is being devoted to the utilisation of low-grade fuels and carbonaceous materials hitherto regarded as waste products.

Our Astronomical Column.

Conjunction of Venus and Mars.—Mr. W. F. Denning writes:—"A very interesting and close approach of Venus and Mars may be well observed in the morning sky of October 3 if the weather is clear. The time of conjunction is at about 11 a.m., when the two planets will be separated by a space of a little more than a third of a degree.

"The best time to observe the event will be at about 4 or 5 a.m., as the sun rises a few minutes after 6 a.m. Venus will appear by far the more brilliant orb of the pair, and its strong silvery light will make the red aspect of Mars feeble and insignificant. This occasion will afford a good opportunity to make comparative observations of this sort, but neither of the planets will be shining at its best; in fact, Mars will be at so great a distance from the earth that its brightness will scarcely exceed that of a second magnitude star.

"The two planets will be situated in the constellation Leo, and about 10° east of Regulus, the most conspicuous star in that constellation."

Observations of Star Colours.—The Vatican Observatory has just published four volumes dealing with observations of star colours on Schmidt's numerical scale (modified by Osthoff). Three of the volumes are separate catalogues, based respectively on the observations of Benedetto Sestini, S.J., at Rome (1844–46), with revision by J. G. Hagen, S.J., of Friedrich Krüger at Aarhus, and of Heinrich Osthoff at Cologne. The fourth is an index catalogue, combining the results of the first three, and adding the Harvard magnitudes and spectral types. The colours, on the whole, follow the spectral types fairly closely; there is, however, a physiological effect, discussed by H. Osthoff, according to which a bright star is estimated as whiter than a faint star of the same tint; he investigated this by observing bright stars with sectors of various angles over the object glass, and found that it averaged 0·3 colour-unit per magnitude. Owing to this effect, the photographic determination of colour-index has advantages over the optical method.

The following are the adopted colour-numbers for some bright stars:—Aldebaran, 6·3; Capella, 3·3; Betelgeuse, 6·5; Procyon, 2·7; Pollux, 4·4; Arcturus, 4·7; Vega, 1·3; Altair, 2·4. It is only among the faint stars of type M*b* that numbers approaching 9 or 10 are found.

The Motion of the Perihelion of Mercury.—This question is now of special interest owing to the close agreement between the value of 43″ per century given by Newcomb and the value 42·89″ deduced from Einstein's theory. Newcomb estimated the probable error of his determination as 2″ per century; but an article by E. Grossmann in *Astr. Nach.*, No. 5115, re-examines the observational evidence, reaching the conclusion that the actual range of uncertainty is much greater. Newcomb based his result partly on meridian observations and partly on transits across the sun. The difficulties in observations of the latter phenomena are well known, consisting partly in the "Black Drop," and partly in the unsteady image which the sun's heat often produces. There is the further fact that the transits all take place at two particular points in the orbit, and consequently are incapable of determining the motion of the perihelion by themselves; they merely lead to an equation between different secular motions. The meridian observations are also not very satisfactory. They lead in the mean to a distance of Mercury from the sun 2″ greater than that corresponding with its period of revolution. Moreover, Herr Grossmann shows that the observations before and after 1850 (about the time when chronographic observation began) have large systematic differences. He finally obtains 29″ and 38″ as the limiting values of the secular motion indicated by the observations. It should, however, be added that a recent series of observations made with the travelling-wire micrometer of the Cape Transit-Circle gave a value very close to that of Newcomb. It may be pointed out that the quantity actually observable is the product of the motion of perihelion by the eccentricity, which amounts to only 8″ per century.